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Business and services models for electric vehicles

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Abstract

This paper introduces the approach for the business models analysis for electric vehicles, as followed in the FP7 EU-funded Green eMotion project [1].

The main goal of Green eMotion is to enable a mass deployment of electric mobility in Europe. For that purpose, Green eMotion will connect ongoing regional and national electric mobility initiatives leveraging the results and comparing different technology approaches to ensure the best solutions prevail for the European market.

A virtual marketplace will be created to enable the different actors to interact and to allow for new high-value transportation services as well as electric vehicle (EV) user convenience in billing (EU Clearing House). In addition, the Green eMotion project will demonstrate the integration of electric mobility into electricity networks and contribute to the improvement and development of new and existing standards for electric mobility interfaces.

In order to facilitate large-scale EVs roll-out in terms of social acceptance, commercial viability and system/environmental impact, the most suited business models should be identified and assessed according to a methodology taking into account all economic transactions between the different participating stakeholders.

Keywords: business model, EV (electric vehicle), infrastructure, smart grid, market

1 Introduction

The Green eMotion project is based on the conviction that electro-mobility in Europe has to be approached in a systematic and holistic way making use of innovative solutions and involving regional stakeholders at the same time. The technical solutions must be interoperable, scalable and standardized to enable a mass market rollout.

For the mass deployment of electric mobility there is a need for new business models which increase benefits for electric vehicle (EV) customers. Examples are interoperable charging, searching and reservation of charging stations and coordinated/smart charging. The latter, for example, is necessary to avoid additional burden on the low voltage/medium voltage (LV/MV) grid when EVs are connected to it and charged according to the usual “fit-and-forget” strategy (without smart management of recharging processes). This challenge can be solved by coordinating the charging of the EVs according to the LV/MV grid capabilities (and in compliance with pricing benefits for the final customer), through the use of coordination signals to spread the EV loads over time e.g. stimulating charging processes to happen when a lot of electricity generated by renewable resources is available. This way EVs, instead of a challenge, can become a real opportunity for the whole business value chain, from DSOs up to the EV customer, by offering new services and allowing a better integration of Distributed Energy Resources (DER) in the energy production mix, so as to exploit electric mobility as a critical opportunity to meet 20 – 20 – 20 EU goals and simultaneously promote the deployment of smart grids.

These new services may lead to significant changes in the current value chain and trigger a disruptive business model innovation, particularly within the conventional energy distribution business of utility companies, as a new proactive role of the DSO is required. In order to turn these challenges into opportunities, new business and service models need to be studied and implemented.

Mass rollout of plug-in hybrid and electric vehicles across Europe creates significant challenges for all stakeholders involved. These challenges need to be thoroughly understood and addressed accordingly to allow for a viable ecosystem.

Green eMotion business models analysis is based on the e^3value methodology [2]. The e^3value methodology is very well suited for network-based businesses, where many participants interrelate with each other, as it happens in the case of the electric mobility ecosystem. The main advantage of the methodology is that it allows an easy identification of the money exchanges between the different participants, in a business model where many agents interrelate with each other.

Different business models are being analysed. In each of them, the money exchanges between the different participants are calculated based on the figures created with the e^3value methodology. Then, additional costs are considered for the key actors (EVSE Operator, EVSP, DSO and EV customers), in order to calculate their annual cash-flows. Once annual cash-flows are obtained, an investment analysis is carried out to check the profitability of the investments they need to perform.

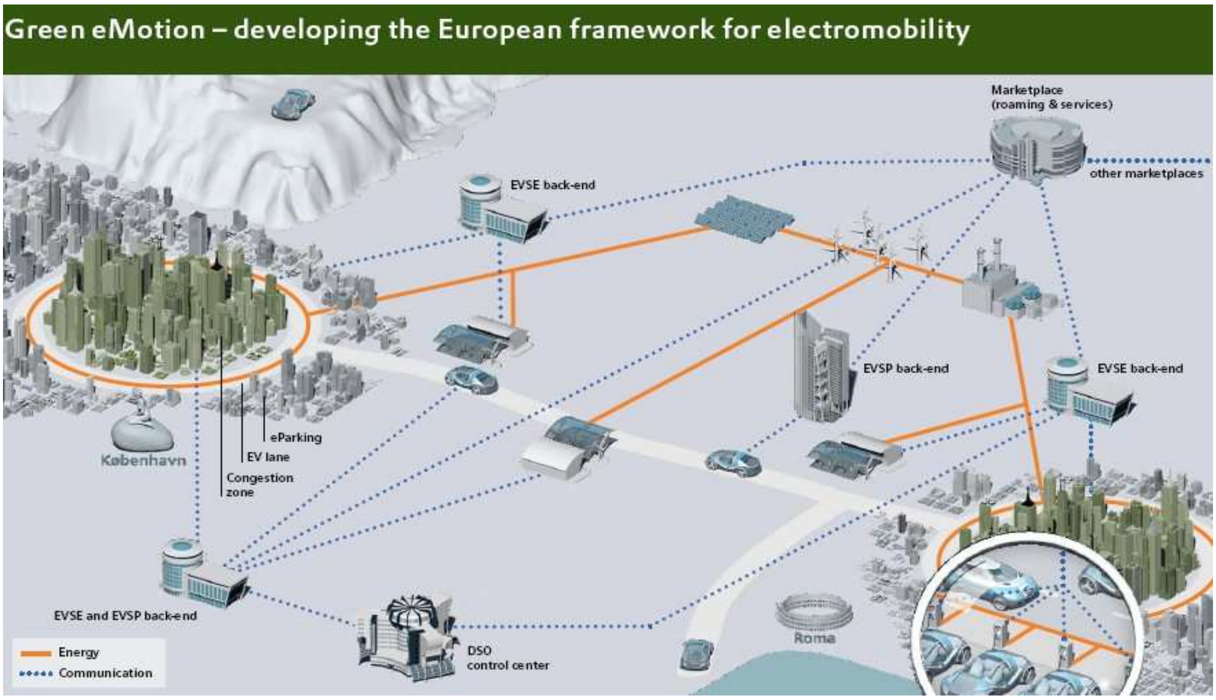

Figure 1: The Green eMotion Project approach

This analysis focuses on the charging service provision, as a preliminary approach, where electric vehicle service providers (EVSPs) offer charging services to their EV customers, and electric vehicle supply equipment (EVSE) Operators offer such service to the EVSPs, getting into the marketplace to search for service providers and service requesters.
Next, according to the on-going work, this basic case will be extended to the provision of new value-added services by the EVSP, also involving advanced interaction between stakeholders within smart charging scenarios.

1.1 Green eMotion and the Business Models approach

The objective of Task 9.3 of the Green eMotion project is to assess the business models according to services that can arise around the infrastructure for EV charging.
The first aim of this task is the identification of the business models most suited to facilitate large-scale EVs roll-out in terms of social acceptance, commercial viability and system/environmental impact. This identification is carried out taking into account Green eMotion partners' views, according to different workshops and meetings to define and shape the business models that best represent the analysis to be developed. The service models adopted in various Demo Regions also constitute an input for this objective.
EV-related business models are networked business models, in which several actors interrelate with each other. In addition, since electricity is a partially regulated sector, new business models need to take into account their effect on the regulated parties. If such effect is negative, either those parties or the regulatory authority can prevent the business model to be carried out. Therefore, the business model analysis looks at the business model developer, its clients, regulated parties in the electricity sector and other participants.
When many actors, with different interests, exchange value with each other, business cases can become rather complex. The analysis of such businesses through traditional methods may result either time-consuming, or oblige to perform simplifications that usually hide important implications of the business for some of the involved actors. In order to overcome such problems, the e^3value methodology [2] was created and adapted to the world of DER [3].
In order to be as generic as possible and not to create very condensed models, the actors presented in e^3value models correspond to archetypal roles. Then, depending on national regulatory or market conditions, each "real" actor can play one or several of the roles presented in the models.
The result of applying this methodology is that all parties involved will have a shared understanding of the business case. When multiple cases are explored, they become comparable, and the most promising cases can be selected for further analysis.
In Green eMotion, a number of business models for mobility infrastructure and services are being analysed and compared. In particular, a Cost Benefit Analysis (CBA) on the selected business models is performed to quantify all economic transactions between the parties involved, and an assessment of the investment economic performance is done.
The e^3value methodology is applied in an especially clever way, due to the complexity of the cases to be analysed, often with multiple and uncertain variables such as:

- Regulatory framework and constraints regarding the electricity network and the e-mobility stakeholders.
- Expected uncertain potential EV deployment.
- Spread diverse subsidies of several condition affecting different actors.

Thus, the proposed business models are chosen so that their results should provide as much quantifiable information as possible, in order to assess the business opportunities for the different players, in a way that new analyses can be identified and carried out in a converging process. All eventual scenarios that could be of potential interest for the EV deployment should be carried out in the best way.
At the end of this document a real example of business scenario is evaluated. After the short description of the main concepts of the e^3value methodology, a graphical model is presented and a brief financial evaluation is carried out.

1.2 Introduction to e^3value methodology

The e^3value methodology was created and adapted to the world of DER to provide a usable tool for analysing complex networked business models.
The main focus of e^3value is the assessment of all economic transactions between the different actors taking part in a business model.

Therefore, the main features of the methodology are that it presents the whole picture of the business case and that it focuses on the concept of economic value. This way, the business cases are represented graphically, showing all the actors which are needed to run the business model (including the business developers, regulated actors and competitors) and the economic relationships between them.

This methodology provides a pre-defined template to describe the business idea at hand, together with a financial analysis, based on investment and operational cash-flow perspective, and a scenario approach. What is more, the methodology offers a common understanding of the business case, because it uses a shared and well defined terminology, available for every stakeholder involved in the business case.

The methodology uses, on the one hand, well established business modelling methodologies for networked enterprises and, on the other hand, traditional economic investment assessment techniques such as calculation of Net Present Value (NPV) and Internal Rate of Return (IRR).

2 Business Models Analysis in Green eMotion

The present focus of the Business Models analysis within Green eMotion project is the selection of the most promising scenarios and use cases in order to help EV roll-out in the best way. Many potential models appear in the debates, and some of them have already been selected for further analysis. Preliminary results of a couple of basic cases are presented in later sections.

At the moment, the main barriers for the widespread adoption of EVs are their high purchase cost, the lack of recharging infrastructure (private and public) and the range anxiety, i.e. the driver's fear of running out of battery before reaching his or her destination.

2.1 Actors and their roles in the EV Business Modelling analysis

As mentioned earlier, the Business Models analysis focuses on the actors who want to launch the business (for instance, Electric Vehicle Supply Equipment Operator or Electric Vehicle Service Provider), and also on all the rest of players that must or can be involved, such as some regulated companies (such as TSO, DSO or Market Operator), liberalised stakeholders (such as retailers or electricity producers), etc.

The definitions below are linked to actors' archetypical roles. The specific names and particular characteristics are presented under the respective headings.

2.1.1 Electric Vehicle Supply Equipment (EVSE) Operator

An EVSE Operator can manage one or some EVSE. ISO_IEC 15118 [4] defines an EVSE as: "conductors, including the phase(s), neutral and protective earth conductors, the EV couplers, attached plugs, and all other accessories, devices, power outlets or apparatuses installed specifically for the purpose of delivering energy from the premises wiring to the EV and allowing communication between them as necessary. For this purpose the EVSE may also include communication to secondary actors".

The EVSE Operator facilitates the access to the EVSE and to the distribution grid.

2.1.2 Electric Vehicle Service Provider (EVSP)

Electric Vehicle Service Provider (EVSP), according to the concept of e-mobility Operator, as defined by ISO_IEC 15118, is the "legal entity that the customer has a contract with for all services related to the EV operation".

Therefore, an EVSP offers e-mobility services to EV customers, so that they can recharge their EVs (either at home, at work or at any other public parking location), including the roaming service (even at any EVSE across Europe), or benefit from additional services while driving/charging. This provision of services, including EV charging, is the feature that characterizes the EVSP.

The main differences between the EVSP and the EVSE Operator are:

- The EVSE Operator is always the player who gets grid access from the DSO.
- Once the EVSE Operator has bought grid access, it offers EVSE access to EVSPs through different means (including, among others, bilateral contracts or individual agreements with a Clearing House). In addition, the EVSE Operator can offer different services to the EVSP, who select the appropriate ones according to its customers' needs.
- The EVSP buys the access to the EVSE (and any other service provided by the EVSE Operator), as well as the required electricity amount, and sells the recharging service to the EV Customers, according to the tariffs and other conditions established in their contract.

The EVSP may have electricity supply contracts with one or several Retailers, or it may even look for potential retailers in the marketplace. The EVSP is the only actor having a contract with EV Customers.

In some countries (e.g Germany, Spain), the EVSE Operator and the EVSP can be the same entity. However, since one of the aims of Green eMotion is proving the roaming concept, they are treated as different entities.

2.1.3 EV Customers

Three different types of EV Customers are defined:

- Institutional: Re-sells services to EV Users.
- Assigned user: Signs a contract with the EVSP.
- Driver: The actual car driver.

The ISO_IEC 15118 defines EV User similarly to the concept of Driver: "Person or legal entity using the vehicle and providing information about driving needs and consequently influences charging patterns".

In the analysis presented here, EV Customers are always be the assigned users.

2.1.4 EV Fleet Operator

A Fleet Operator is defined by the ISO_IEC 15118 as: "A person or legal entity operating several EVs and may have the contracts with electricity provider".

In this case, companies or government agencies may own or lease a fleet of EVs.

In general, fleet sizes range from a few cars for a Small Medium enterprise to dozens of thousands.

2.1.5 Energy Market Aggregator

An Energy Market Aggregator uses small volume inputs and creates saleable portfolios to be sold on different electricity markets (e.g. reserve power markets). The power load of a single EV is very limited, but with a pool of EVs it is possible to reach tradable product sizes. With aggregation, customers become active parties in the electricity markets and can gain cost savings for electricity.

EVSPs, retailers and other stakeholders could act as energy market aggregator. Retailers, in fact, have much information about their customers, and then a relevant knowledge of customer behaviour and market. EVSPs have access to several aggregated EVs, which can function as storage units when plugged in the network during office hours or the time spent in a shopping mall, airport, public parking, etc.

2.1.6 Clearing House

The ISO_IEC 15118 defines Financial Clearing House as the "Entity mediating between two clearing partners to provide validation services for roaming regarding contracts of different electricity providers with the purpose to:

- Collect all necessary contract information from all participating electricity providers. Example: contact ID, electricity provider communication path to electricity provider, sales tariffs, begin end date of contract.
- Provide the EVSE communication part with confirmation that an electricity provider will pay for a given Contract ID (authentication of valid contract).
- Transfer a Charge Detail Record after each charging session to the electricity provider of the identified contract.

Financial Clearing House, e-mobility provider and meter operator may exchange information with each other as well as other actors".

In Green eMotion, the Clearing House is a mediation entity between more partners, rather than only two.

2.1.7 Meter Operator

A Meter Operator is defined as the "Body having the legal responsibility for installation and maintenance of electricity meter" [4].

This function is often carried out by the DSO itself and as such is considered here.

2.1.8 Distribution System Operator (DSO)

The Distribution System Operator (DSO) is a natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the distribution system in a given area and, where applicable, its interconnections with other systems and for ensuring the long-term ability of the system to meet reasonable demands for the distribution of electricity [5].

2.1.9 Transmission System Operator (TSO)

The Transmission System Operator (TSO) is a natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the transmission system in a given area and, where applicable, its interconnections with other systems, and for ensuring the long term ability of the system to meet reasonable demands for the transmission of electricity [5].

In addition, the TSO shall be responsible for managing electricity flows on the transmission system, taking into account the electricity exchanges with other interconnected systems.

To that end, the TSO shall be responsible for ensuring a secure, reliable and efficient electricity system and, in that context, for ensuring the availability of all necessary ancillary services, including those provided by demand response, insofar as such availability is independent from any other transmission system with which its system is interconnected.

2.1.10 Electricity Retailer

Electricity Retailers purchase electricity in the wholesale market and resell it within the system. For private customers, the retailer usually supplies electricity and grid access. In this case, the retailer is the only interface with the customer and therefore responsible for invoicing.
For larger customers, retailers only sell electricity while grid access and usage may be charged directly by the DSO.

2.1.11 Original Equipment Manufacturer (OEM)

An OEM is the "Company which builds a new product that is different to all other products made by other companies" [4].
For the purpose of Green eMotion, OEMs are car manufacturers.

2.1.12 Service Providers

The Service Provider offers several useful value added services optionally available via the Marketplace. This may include the current location of the driver, average amount of energy charged while parking, timetables of public traffic, tourist information or weather forecast, etc.
The Green eMotion project focuses on value added services which create additional revenue for the electromobility infrastructure and/or foster green transport behaviour.

2.1.13 Telecommunication Provider

The electric mobility system needs to be able to communicate in order to exchange information. This is often carried out wirelessly, e.g. over GSM or 3G. Therefore, infrastructure to enable the communication between the EV, the EVSE infrastructure (Charging Stations, Battery Switch Stations, etc) and backend services need to be provided.
Herewith, it becomes obvious that communication standards are crucial for a fully functional system, which enables access to any company that adopts the standard.

2.1.14 Market Operator

The Market Operator is responsible for wholesale electricity market trade and it is the sole counterparty for all market transactions. Therefore, market participants do not trade with each other, but through the Market Operator, so, somehow, it is as if the Market Operator "sells" electricity to retailers and "buys" it from producers. Market Operator activities might be paid by the producers, by the retailers or by both, and according to the amount of energy traded in the market.

2.1.15 Marketplace Operator

Operates the platform and communications and manages access to and working of the marketplace.

2.1.16 Balancing Responsible Party

Balancing Responsible Parties (BRP) are requested to pay for the imbalances created by the parties they represent. The difference between the energy amount that a market participant has traded in the market and the energy amount that such participant has produced or consumed is that participant's imbalance. BRPs consolidate the imbalances of the parties they represent and are charged for the imbalance in their portfolio by the TSO. It subsequently compensates financially the TSO for negative imbalances observed in real time, or it receives financial compensation from the TSO in case of positive imbalances.

2.2 Business Scenarios

Green eMotion analyses a series of business models which can help overcome existing barriers and facilitate EV deployment. In any business model, the EV Customer is a key participant, since he or she is the one actually buying the EV.
When looking at the purchase price, even it is fairly higher in EV than in the comparable internal combustion vehicle (ICV), running costs are much lower. In order to assess the profitability of buying an EV instead an ICV, a Total Cost of Ownership (TCO) model must be created for both alternatives, including acquisition, maintenance and "fuel" cost and any other costs related to vehicle ownership.
As for the recharging infrastructure, the EVSE Operator business model is analysed. The EVSE Operator invests in EVSE and charges a fee for giving access to them, so that EV can be charged. Its cost structure includes EVSE maintenance cost, the cost of communication between EVSE and EVSE backend, and personnel cost. The number of EVSE to be installed (and hence its cost) and the fee to be charged strongly depend on the number of EVs that potentially can connect to its EVSE.

Regarding the range anxiety, it is a subjective perspective for each potential EV buyer, which can only be reduced by improving driving experience. For that purpose, the EVSP business model will be very important, since the EVSP is the actor who gathers services (including electricity delivery, access to EVSE and other value-added services) from different providers and offers them to EV customers. The EVSP needs to seek for services of interest for the EV customer, so that the customer is willing to pay for them. Within its cost structure, communications and personnel costs are important subjects.
EV customers' TCO and the business models for the EVSE Operator and the EVSP are strongly correlated. A change in the fee to be charged by the EVSE Operator will influence the price to be charged by the EVSP to the EV customer for EV charging and, hence, customers' TCO. Likewise, as the TCO decreases, the number of EVs will increase and, thus, the number of potential EV customers for the EVSE Operator, so the fee for EVSE access can also be lower.
In addition, the mass roll-out of electric vehicles needs the collaboration of some other actors, such as the DSO or the TSO, whose activities (and profitability) will strongly be influenced by the electricity demand increase derived from EVs.
If EVs are to be widespread adopted, all the actors involved in the EV environment must see a positive profitability. As a result, a global approach is needed, i.e. the business model analysis needs to assess the impact of the different business models in all these actors.
The business models presented here are based on a previous business scenario analysis [6].

Table 1: Summary of business scenarios

ID	Business scenario	Priority
C1	Charging a. at home/ b. semi-publicly / c. publicly	1
C2	Differentiation of customer contracts	2
C3	Mono-directional control of charging	2
C4	Bi-directional control of charging (V2G, V2H)	2
S1	Marketplace: buying, selling, routing	1
S2	Service detail records for accounting and billing	1
S3	B2B contract management	1
S4	Service provisioning/registration/life cycle management	1
S5	Standardization of interfaces, messages (for remote customer service)	1
S6	B2B partner management	1
R1	Roaming both between EVSE Operators and between countries/regions	1
R2	Authentication (for all kind of services) -> contract	1
R3	Validation of contracts (from, to, scope, tariff info, ...)	1
O1	Core driver scenarios (best charging, reservation)	1
O2	Additional value added services (analytics and reporting, eco-routing)	2
O3	Innovative services (advanced charging, maintenance)	3
E1	Grid related value added services (Congestion management)	1
E2	Energy trading value added services (VPP, imbalance)	2
E3	Energy retail value added services	2

From consumers' perspective the business scenarios C1b, C1c, R1 and O1 are relevant and are expected to meet customer's willingness to pay for these services. On the contrary, functions like authentication and authorization (category R) are a prerequisite for the operation of an EV, but there is no stand alone business case for these basic services. However, these features are part of other business scenarios and, if a cost impact occurs, have to be included in the value chain.
In order to facilitate these business models, a "Clearing House" is need to rout these request (e.g. request for availability and subsequent reservation) from the EV user, towards an EVSP backend, and to the supplier (e.g. EVSE Operator). In this context the business scenarios S1 to S3 seem to be a "core function" and should be combined to one business idea of a "Clearing House".

2.3 Example of Business Model analysis: Basic charging with Marketplace and Clearing House

Every EV customer needs to charge his or her electric vehicle. In order to give answer to that demand, EVSPs offer recharging services to EV customers.

The basic charging business model is hereby analyzed under the hypothesis of a complete unbundling of roles, e.g. each of the aforementioned actors is independent and the CBA analysis refers to such framework. In further work, different results will be derived according to more specific regulatory frameworks under discussion in some Green eMotion demo regions, e.g. with the EVSE Operator role to be executed by the DSO, leading to different CBA results for the same basic charging model involving the Clearing House and the Marketplace.

This business model will likely appear in the future, when the numbers of EVSPs and EVSE Operators increase, with the corresponding increment of the costs of managing the contracts with the other parties. The Clearing House gives an answer to this problem, by acting as the sole clearing counterparty with all its clients.

The Marketplace Operator establishes a software platform, where different EV market participants, such as EVSPs and EVSE Operators can offer and seek for services. In the basic charging business model, the EVSE Operators can offer themselves in the marketplace, where the EVSP looks for the most convenient EVSE for its EV Customers.

The EVSP creates value for its EV Customers by offering them the possibility to charge their vehicles. The EVSE Operator creates value for the EVSP by outsourcing all the issues related to the recharging infrastructure investment and maintenance. The Clearing House offers EVSPs and EVSE Operators a reduction in contract handling costs, together with a guarantee of service delivery and payment. The Marketplace Operator offers access to a platform where different service providers and requesters can find counterparty.

The incomes for the EVSP are the payments for EV charging made by EV Customers and its expenditures include the payments for electricity to the Electricity retailer, to the Clearing House for both the access to the EVSE and the clearing, and payments for communication to the Telecommunication provider. On top of these, the EVSP pays for the company running costs.

On the other hand, the EVSE Operator receives the payment for access to the EVSE, but it needs to pay for grid access to the DSO, for clearing to the Clearing House and for communications to the Telecommunication Provider. In addition, the EVSE Operator also pays for the investment in EVSEs and for the company running costs.

The DSO receives Transmission & Distribution (T&D) fees from the EVSE Operator, but it needs to transfer the regulated part to the TSO and pay for communications to the Telecommunication provider.

The Clearing House receives the payments for clearing and pays for communications and for the company running costs.

The Clearing House certainly provides benefits to both EVSPs and EVSE Operators, in terms of increased accessibility to EVSEs and EVSPs, respectively. However, it is likely that each of them would still have partner counterparties, so that the clients of a given EVSP can use its partner's EVSEs without the need to use the Clearing House.

This business model is a first step for EVSPs to start looking for value-added service providers, as EV Customers start demanding those services.

The e^3value model for this service is presented in Figure 2:

- EV Customers 1 and 2 want their EVs to be charged (dark green start stimulus), so they pay for that to their respective EVSP.
- In order to be able to satisfy such request, the EVSP needs to get access to the EVSE (pink lines), to obtain the right to receive electricity from the Electricity retailer (light green lines), and to pay for using its communications (yellow lines). In addition, when EVSP 1 needs to get access from an EVSE Operator different from EVSE Operator 1 (which it has a bilateral contract with), it has to use the Clearing House service, and hence, it must pay for it (orange lines). Besides, if the EVSP needs to use the marketplace to seek for the EVSE Operator, it must pay for accessing the marketplace. For every charge that EV Customers request, the EVSP uses communications once, pays for one access to the EVSE and for one use of both the Clearing House and the marketplace, but the payment to the Electricity retailer depends on the number of kWh actually recharged, as shown by the implosion in the light green line.
- The EVSE Operator pays for communication (yellow), for grid access to the DSO (brown lines) and, in the case of providing access to an EVSP it has no contract with, for using the Clearing House (orange lines). In addition, when it offers itself in the marketplace, it has to pay for the marketplace access fee. As T&D fee depends on electricity consumption and not on the number of charges, there is another implosion in the brown path.

- In order to be able to provide their services (clearing and access to the marketplace), the Clearing House and the Marketplace Operator must pay for communications.
- Part of all the money received by the DSO is transferred to the TSO, according to each country's particular requirements (brown lines).
- The Electricity retailer buys electricity in the wholesale market (blue lines) and the difference between the purchased amount and the actual electricity consumption is paid to the BRP (purple lines).
- The BRP pays for imbalances to the TSO.
- The TSO uses the payment for imbalances to pay for system balancing to Electricity producers.
- Likewise, all electricity traded in the market is provided by these Electricity producers.

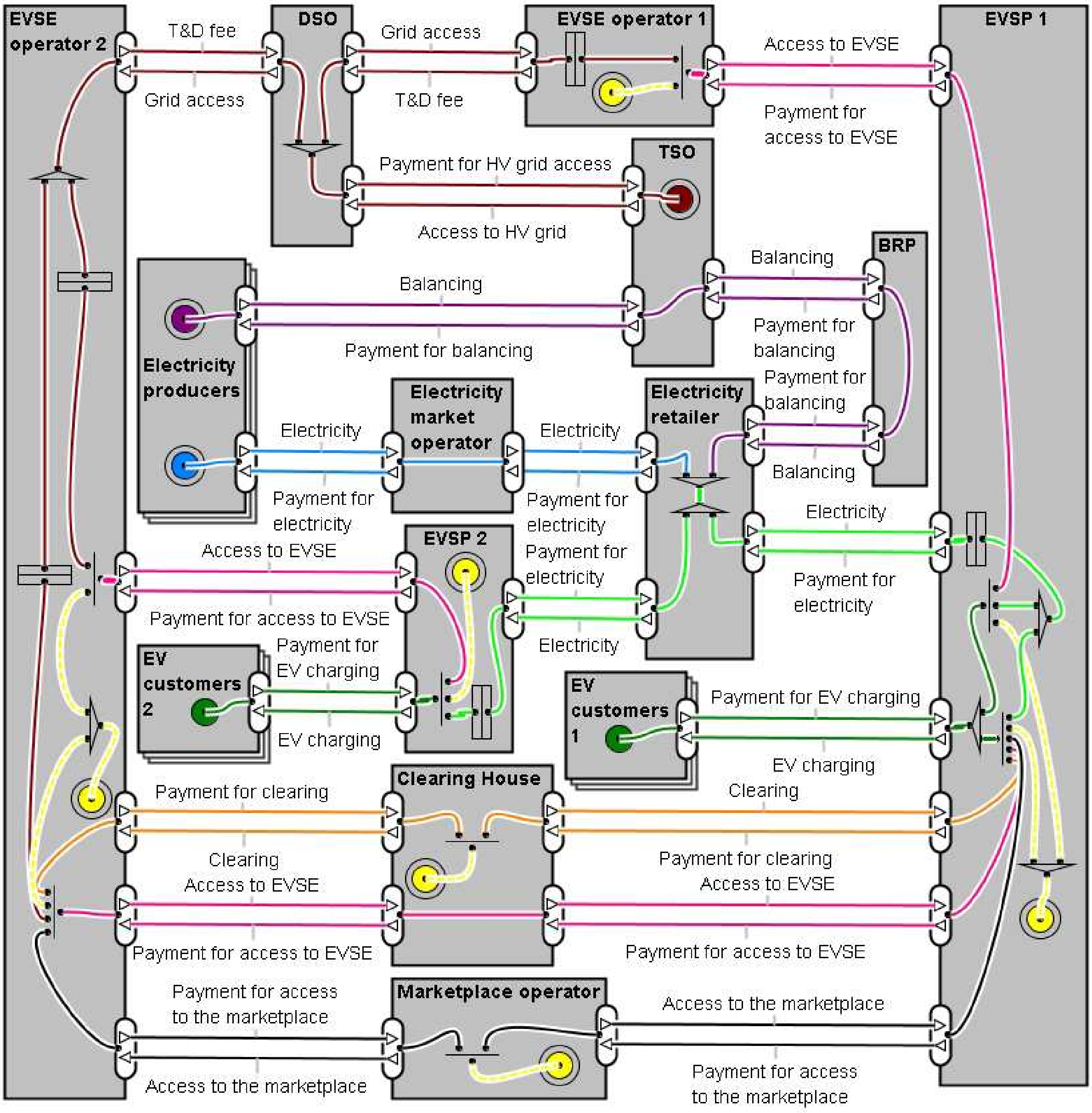

Figure 2: e[3]value model for the basic charging business model (Marketplace and Clearing House)

3 Cost-Benefit Analysis

The feasibility of a business model can be assessed by calculating its economic impact on each of the relevant actors involved in EV roll-out, both directly and indirectly.

For that purpose, a Cost-Benefit Analysis (CBA) tool was created, which calculates the annual money exchanges for all the actors under analysis, based on the figures created through the e^{3}value tool.

The tool considers the relationships between the different actors, the formulas ruling them and the data needed for making the calculations.

These money exchanges obtained from the tool are then used as an input to calculate key actors' cash-flows, by considering the rest of costs they need to satisfy for launching the business model. These other costs include, for example, client management systems or RFID card printing in the case of the EVSP, TCO models for EV Customers, and the increase in operational costs for the DSO.

Once annual cash-flows are obtained, an investment profitability analysis is performed to check the profitability of the investments they need to perform.

Since in most countries wholesale market prices can change every hour, annual cash-flows are calculated adding hourly cash flows. Likewise, each actor's hourly cash flow is made up of all the in- and out-flows of money in that hour.

Such flows are calculated from simple formulas, which represent the relationships between the actors, and use the appropriate data.

Many of the financial parameters in a business model are difficult to estimate. Consequently, this analysis identifies the future steps which may strengthen the business case or threaten. Such events may influence valuations or even the structure of the value model itself.

3.1 Some preliminary rough results from the Cost-Benefit Analysis

In this section some rough results, obtained from the CBA tool, for the case when just the EV public charging service is carried out, are drafted. These results are not intended to guarantee the results for a potential investment right now, but just to show which type of analysis is being made and some first results. The assumptions, data and issues to be taken into account are being improved with the support of industrial partners within the Green eMotion project.

The basic assumptions, which can be easily modified, just to be able to make conclusions according to sensible round particular figures, are as follows:

- The EVSP has 2000 customers.
- Each EV Customer charges once a day in public EVSEs.
- In each charge, EV Customers demand 10 kWh.
- The price to be paid for the electricity to the Electricity Retailer is 78.18 €/MWh.
- The yearly administrative and operational cost for the EVSP is 30 k€.
- The yearly commercial and customer management-support cost for the EVSP is 100 k€.
- The cost related to the EVSP publicity and advertising amounts 100 k€.
- Other costs related to the EVSP business start up of 5 k€ averaged every year.
- The EVSE Operator needs to have 1000 EVSEs for supplying the 2000 customers by the EVSP.
- Each EVSE costs 1000 € and its life is 20 years.
- The price to be paid for T&D access to the DSO is 64.139 €/MWh.
- The yearly administrative cost for the EVSE Operator is 30 k€.
- The yearly operational and maintenance cost for the EVSE Operator is 20 k€.
- Other costs related to the EVSE Operator business start up of 5 k€ averaged every year.
- Every transaction through the marketplace amounts 1 c€.
- Every transaction through the clearinghouse amounts 1 c€.
- Every connection to the Telecommunication Provider amounts 1 c€.

In order for the EVSE Operator and the EVSP to get significant annual benefits (around 100 k€):

- The EVSE Operator needs to get a profit of about 0.4 €/charge. It main cost per charge is the T&D fee, which is about 64 c€ (64.139 €/MWh * 0.01 MWh/charge). As a result, the EVSE Operator needs to charge a minimum access fee of 1.04 €/charge.
- The EVSP needs to get a profit of about 0.5 €/charge. EVSP main costs per charge include the electricity from the retailer and the access to the EVSE. Electricity price is about 78 c€ (78.18 €/MWh * 0.01 MWh/charge).

- Therefore, the minimum price to be collected from EV Customers per charge is about 2.35 € (104 c€ + 78 c€ + 50 c€).

This implies a “fuel cost” for consumers of about 850 €/year, which is about 500 €/year less than the petrol cost for an ICV. If the difference of purchase price between an EV and an ICV is considered to be about 10 k€, the fuel cost difference would require about 20 years to pay for the purchase price difference, assuming that the EV runs about 18,000 kilometres per year, which is far longer than the usual car lifetime.

In order to improve the economics for the different actors, some alternatives that could be considered would be to combine this public charging with private charging at home, so that, most of the times, EV Customers see lower charging costs (by charging at night, both electricity prices and T&D fees should be lower). These lower charging costs can result in EV Customer “fuel” cost of about 500 €/year.

In this case, however, it should be considered that the EVSP would most likely have in the range of 100,000 consumers, so that, on a daily average, 2,000 of them make public charging). With this larger client portfolio, EVSP fixed costs would be higher.

4 Conclusions

The Green eMotion EU project aims to develop the European framework for electromobility. One of its objectives is the identification and development of the business models most suited to facilitate large-scale EV roll-out.

The grounds for the business model analysis have been established, by selecting the first bunch of business models, and by building up the Cost-Benefit Analysis tool to analyse them.

Some first results have been already obtained for some business scenarios, according to a number of particular reasonable assumptions. These assumptions and data need however to be further refined with the support of the industrial partners within the project.

This process is expected to come up with relevant outcomes and recommendations to help industry and regulatory stakeholders carry out the best and most profitable strategies regarding EV and their rational deployment.

List of Abbreviations

BRP	Balancing Responsible Party
B2B	Business to Business
CBA	Cost Benefit Analysis
DER	Distributed Energy Resources
DSO	Distribution System Operator
EU	European Union
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
EVSP	Electric Vehicle Service Provider
FP	Framework Programme
ICV	Internal Combustion Vehicle
IEC	International Electrotechnical Commission
IRR	Internal Rate of Return
ISO	International Organization for Standardization
LV	Low Voltage
MV	Medium Voltage
NPV	Net Present Value
OEM	Original Equipment Manufacturer
RFID	Radio-Frequency Identification
TCO	Total Cost of Ownership
TSO	Transmission System Operator
T&D	Transmission & Distribution
UCM	Use Case Maps
VPP	Virtual Power Plant
V2G	Vehicle to Grid
V2H	Vehicle to Home

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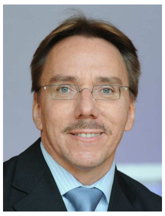

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